

Medusa - The goddess guardian of the thresholds between the realms of heaven, earth and the underworld.



Medusa Sea Floor Monitoring System

Objective: The development of technologies to enable fundamental research into understanding the potential for and limits to chemolithoautotrophic life.



Background

- Chemolithoautotrophy is primary production without photosynthesis.
- These are ecologies within which inorganic carbon is converted to organic carbon and only inorganic compounds serve as electron acceptors and electron donors. (abiotic life)
- It has been hypothesized that one such environment is associated with hydrothermal vent structures.
- The goal of this proposal is to develop an instrument capable of testing this hypothesis



Relevance to NASA Missions

- This field of research is important because it may help to define the potential for extraterrestrial life in our solar system and the origins of life on Earth.

Example

- Observations of Jupiter's moon, Europa have indicated that Europa may harbor a liquid ocean beneath an outer ice crust.
- If true, it is likely that this ocean exists due to the gravitational interactions between Europa and Jupiter not solar energy.
- But could life exist in such an ocean devoid of the input of photosynthesis?



Relevance to NASA Missions

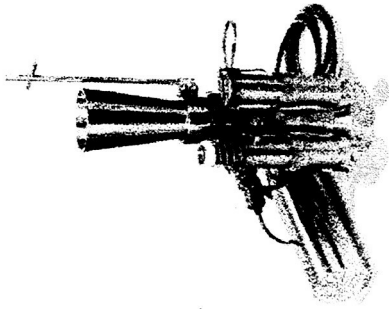
Continued

- Life on Earth is a delicate balance between reducing and oxidizing species.
- Oxidizing species are primarily derived from photosynthesis.
- On Earth it is unclear if there are any examples of life forms based solely on redox chemistry.
- Verification of the existence of natural ecologies that support such organisms would significantly expand our understanding of the potential for life in our solar system and potentially the origins of life on Earth.



Technology Requirements

- To accomplish this task will require the development of a unique instrument package.
- This package must be capable of monitoring basic physical, chemical, and biological parameters in remote and harsh environments over long temporal durations.

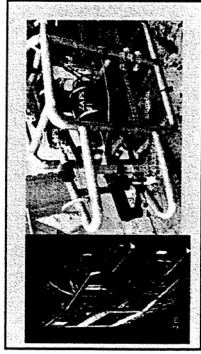


Medusa System Description

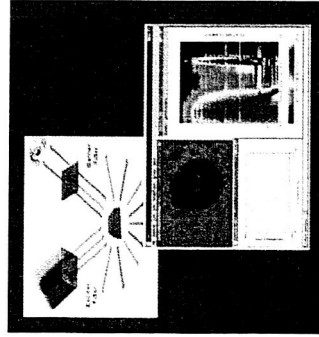
- The core of this system will be the Medusa instrument.
 - Medusa provides sample collection and storage functions as well as power, data storage, data processing, communications, temperature sensors and flow sensors.
- In addition to Medusa several add-on instrument packages are being developed for integration into the core system.
 - These instruments are:
 - An in situ flow through Cl⁻, Mn, FeIII chemical sensor,
 - A ¹²C/¹³C isotope ratio spectral detector
 - An intrinsic fluorescent based microbial detector.
- The fully integrated system is called the Medusa Sea Floor Monitoring System (MSMS).

Medusa Components

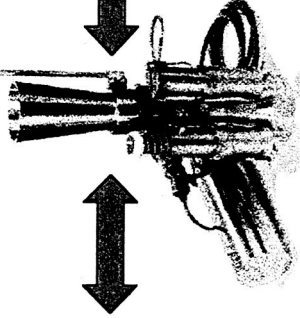
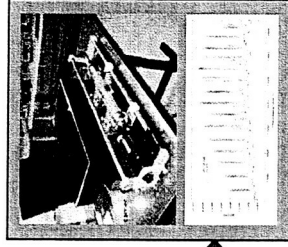
Flow Through Chemical Sensor



Intrinsic Fluorescence Microbial Detector

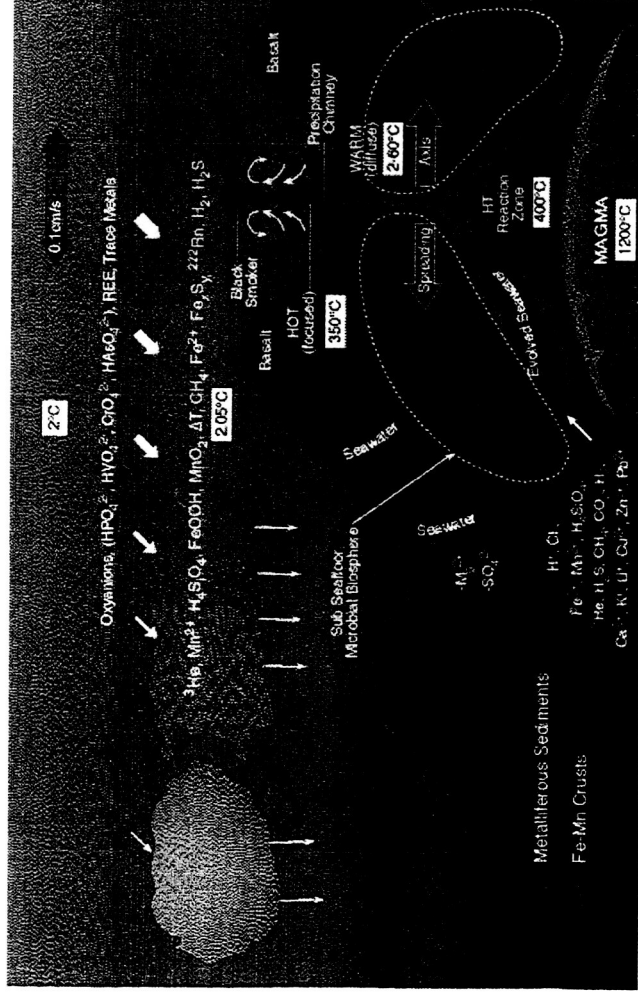


$^{12}\text{C}/^{13}\text{C}$ isotope Ratio Spectral Detector

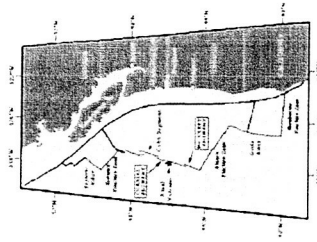
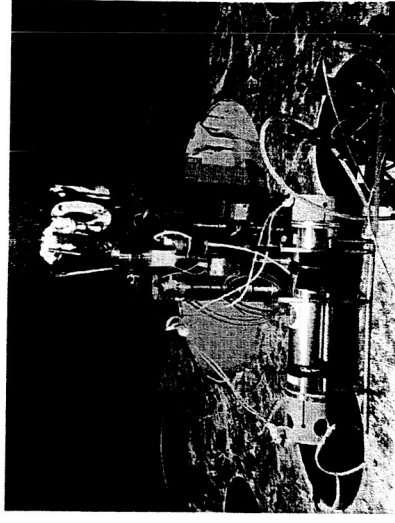
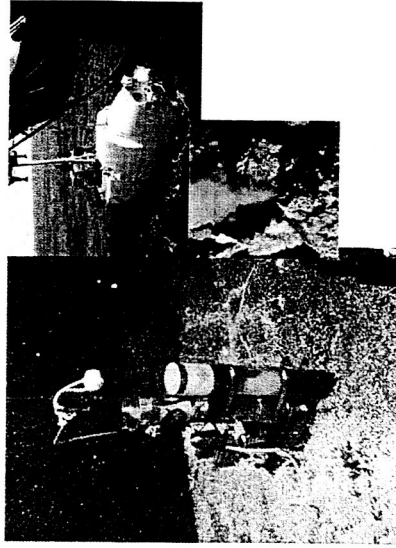


Medusa Backbone

Medusa Science Capabilities



- Medusa is designed to characterize the flux of buoyant material ejected from deep hydrothermal vents and bore holes.
- This material provides information concerning the depth of the sub-sea floor zone, temperature profiles, information defining connectivity to the bulk ocean, biomarkers, and even samples of organisms which have been flushed from deep beneath the sea floor.
- These environments are a potential access point to the theorized deep hot biosphere



Medusa Capabilities

Medusa will be capable of measuring:

- Hydraulic Flow Patterns
 - *Medusa flow and temperature sensors*
- Effluent Chemistry
 - *In Situ Flow-through Spectrometric Chemical Sensor*
- Biology
 - *Cavity Ringdown C12/C13 Measurements*
 - *Intrinsic Fluorescence*



Schedule

Tasks	Year 1				Year 2			
	1	2	3	4	1	2	3	4
1. Development of the Next Generation Medusa								
Fabricate new system based on existing design								
Integrate network instrument protocols								
Expand power and data storage capabilities.								
2. Validation Studies								
In situ Flow-through Spectral Chemistry system								
Module Development								
Laboratory testing								
Field testing								
Cavity Ringdown I2C/I3C System								
Laboratory testing								
Intrinsic Fluorescence Instrument								
Laboratory testing								
Field testing								